

Non-Euclidean Geometry.

As many mathematicians give very little thought to the theory of sets, it is perhaps worth while dwelling for a moment on Dr. Sommerville's possibly misleading remarks in NATURE of October 5. He, quite correctly, points out the one-one correspondence between the aggregates of integral numbers 1, 2, 3, &c. (n), and even numbers 2, 4, 6, &c. ($2n$). Thus the part appears equivalent to the whole. This statement loses the character of a paradox to all who will bear in mind that the notion of "the part cannot equal the whole" has its origin in the contemplation of finite quantities.

Again, the sets of numbers of the form $4n$ and $4n+2$ constitute aggregates of the same type; they are equivalent to each other as well as to n itself and $2n$. I fail to see that Dr. Sommerville shows the part to be larger than the whole. An aggregate A would be larger than A' if A contained a set equivalent to A', while A' does not contain a set equivalent to A.

HAROLD M. SADOW-PITTARD.

SS. Caledonia, October 14.

In drawing a parallel between Legendre's proof and the paradox concerning infinite aggregates, I had not thought it necessary to point out the fallacy, which consists, as in Legendre's proof, of transferring to infinities notions which are derived from a study of finite magnitudes.

Of the two propositions, a part is (1) equal to, and (2) greater than, the whole; the one is just as much a paradox as the other until the meaning of the terms equal, greater, and less has been extended and modified for infinite aggregates; and the proofs which I gave are equally in accordance with notions derived from finite aggregates. Neither of them was intended as a valid proof, though the first happens to be in agreement with the usual extension of the meaning of equivalent.

D. M. Y. SOMMERVILLE.

The University, St. Andrews, October 23.

Dew-ponds and the Dry Season.

WITH reference to the remark in NATURE of October 26 (p. 559), I paid a visit to the Chanctonbury Dew-pond about the end of last August, and was surprised at its flourishing condition.

The water-level was, of course, much below the normal, and the surrounding water plants were much trodden under by sheep and cattle. There still remained, however, a good fringe, and the usual pond plants seemed to be in a satisfactory state. I could not get to the water's edge owing to the moist and boggy nature of the ground, usually submerged.

Some other dew-ponds met with in the course of a few days' walk west of Chanctonbury were quite dry, so far as I remember.

J. P. CLATWORTHY.

University College, Reading, October 30.

CHARLES DARWIN'S EARLIEST DOUBTS CONCERNING THE IMMUTABILITY OF SPECIES.

IN view of the great revolution in scientific thought which was inaugurated by the publication of the "Origin of Species," the story of the evolution of ideas in the mind of its author must always have a deep fascination for the student of the history of science—and the question of the nature of the initial stage of that evolution is one especially worthy of attention.

In his autobiography, Charles Darwin has declared his belief that, before leaving England for the memorable voyage in the *Beagle*, he was quite indifferent to any speculations upon the subject of evolution—and this in spite of his admiration for his grandfather's "Zoonomia" as a literary production.¹ Now concerning the exact period in his life when Darwin ceased to feel this indifference, and had his interest aroused by that "mystery of mysteries"—to the solution of

which his whole after-life was to be devoted—there have been very marked differences of opinion.

Huxley stated his conviction to be that no really important fruits of the observations made during the voyage of the *Beagle* could have been gathered by the ardent but untrained young naturalist until after he reached England, and had the opportunity of consulting specialists concerning the specimens which had been sent home by him from time to time.² But, on the other hand, Dr. Francis Darwin and Prof. Seward maintain that during the voyage, and especially towards its close, when the Galapagos Islands were visited, Darwin's observations and his meditations upon them had already begun to bear fruit, and had led him to lose his absolute faith in the immutability of species.³ I am myself convinced, as the result of a careful consideration of letters written at the time, that *very early indeed in the course of the voyage* certain observations and reflections had given rise in Darwin's mind to *serious misgivings* concerning the fixity of species, although, writing nearly fifty years afterwards, he dismissed them lightly as nothing more than "vague doubts."

It was this statement in Darwin's correspondence to which Huxley appears to have attached very great importance. It occurs in a letter to Dr. Zacharias and is as follows:—

"When I was on board the *Beagle* I believed in the permanency of species, but as far as I can remember, vague doubts occasionally flitted across my mind."⁴

It should be borne in mind, however, that as these lines were written as late as 1877, to one of his very numerous casual correspondents, we may not improbably infer that Darwin penned them somewhat hastily and without any deep thought or reflection concerning the interpretation that might be put upon them if published. For it must be remembered that nearly twenty years before this he had written and printed the following:—

"When on board H.M.S. *Beagle* as naturalist, I was much struck with certain facts in the distribution of the inhabitants of South America, and in the geological relations of the present to the past inhabitants of the continent."⁵

Seeing that these words form the first sentence of the introduction to the "Origin of Species," and must therefore have expressed the result of very deliberate thought and consideration, that they would certainly have been frequently scanned by the author before publication, and that they are repeated without change or qualification in every succeeding edition of the book, it is undoubtedly only fair to attach far greater weight to them than to a sentence hastily indited to a casual correspondent so many years afterwards.

In that marvel of candid introspection, the "Autobiography," Darwin wrote in 1876 as follows:—

"During the voyage of the *Beagle* I had been deeply impressed by discovering in the Pampean formation great fossil animals covered with armour like that of the existing armadilloes."⁶

And this he enumerates as the *first*, though *not the most important*, of the observations which turned his thoughts in the direction of evolution during the voyage. When writing to Haeckel in 1864 he says:—

"I shall never forget my astonishment when I dug out a gigantic piece of armour like that of the armadilloes."⁷

Owing to a singular blunder, for which Darwin was in no way responsible, I shall have to point out that

² "Collected Essays," vol. ii., p. 271.

³ "More Letters of Charles Darwin," vol. i., pp. 37-39. See also "Foundations of the Origin of Species," p. xv.

⁴ "More Letters of Charles Darwin," vol. i., p. 267. The italics in this and succeeding passages are our own.

⁵ "Origin of Species," p. 1.

⁶ "Life and Letters," vol. i., p. 82.

⁷ "History of Creation," vol. i., p. 134.

¹ "Life and Letters of Charles Darwin," vol. i., p. 38.

the significance and importance of this *fateful* discovery—for such I believe it to have been—has to some extent been overlooked; but concerning the time and place that it was made, and all the circumstances connected with it, we fortunately have ample information.

During the first six months that he spent in South America (March to September, 1832), Darwin tells us that he had "procured a nearly perfect collection of mammals, birds, and reptiles" in the districts around his two great centres of work at this time, namely, Botofogo Bay, near Rio de Janeiro, and Maldanado, near Monte Video.⁸ In doing this he could not fail to be greatly struck by the peculiarities of the fauna, with its sloths, ant-eaters, and armadilloes. From the journals both of Fitzroy and Darwin, we learn that questions concerning the several species of armadilloes and their geographical range were at this time engaging their attention.⁹

It fortunately happened that, during the autumn of 1832, the *Beagle* was delayed for some weeks in Blanco Bay. The energetic young captain (Fitzroy was at this time twenty-seven years of age, only four years older than Darwin himself), finding that, in his own ship, he could not safely survey the shallow waters of the South American coast, purchased, at his own expense, two tiny undocked sealing craft and placed them under the command of two of his officers who volunteered for the service. While the alteration, refitting, and rigging of these dirty little vessels was in progress, the *Beagle* was delayed at her anchorage, and Darwin found an opportunity of which he took splendid advantage.

Near Punta Alta, on the shores of the Bay of Bahia Blanco, there is a cliff about 20 feet high extending for the distance of a mile; the beds exposed in this cliff consist of false-bedded gravel, sand, and marl, in which were many shells which Darwin recognised as belonging to existing species. But in the midst of these sands and gravels could be seen a lenticular bed of red mud, in which the bones of great quadrupeds occurred in such abundance that remains of nine large mammals were disinterred from an area of 200 square yards.¹⁰

Under the date of September, 1832, Captain Fitzroy wrote in his journal as follows:—

"My friend's" (Darwin's) "attention was soon attracted to some cliffs near Point Alta, where he found some of those huge fossil bones, described in his work, and notwithstanding our smiles at the cargo of apparent rubbish which he frequently brought on board, he and his servant used their pick-axes in earnest, and brought away what have since proved to be most interesting and valuable remains of extinct animals."¹¹

Doubtless, while his other shipmates were content with exhibiting mild amusement at the eagerness of "the Flycatcher," as Darwin was called by them, the martinet first-lieutenant, as is recorded in the "Life and Letters," would be moved to wrath by the state to which his decks were being reduced by these strange proceedings, and driven to employ choice nautical language concerning "the d—d beastly devilment," not forgetting to add, "If I were skipper, I would soon have you and all your beastly mess out of the place."¹²

It was probably on this occasion that Darwin experienced those pangs of "despair with which he had to break off the projecting end of a huge, partly

excavated, bone, when the boat waiting for him would wait no longer"—a sorrow which, as his son tells us, he often recalled and spoke of in after-life.¹³

We must bear in mind that Darwin collected from this treasure-house of mammalian remains at Punta Alta on two different occasions, first in September, 1832, and secondly in August, 1833.

That it was on the *first* of these occasions "the gigantic piece of armour like that of the armadilloes was procured" is fortunately proved by a letter written by Darwin to Henslow, dated November 24, 1832, and communicated to the Cambridge Philosophical Society before the *Beagle* had returned to England.¹⁴ The opportunities which the young naturalist then enjoyed of having boats and men at his disposal to transport these great bones of the Pampas formation to the ship, appear to have been unique.

In the very important letter to which I refer, Darwin speaks of finding "fragments of at least six different animals," including "a large surface of the osseous polygonal plates, which 'late observations' (what are they?) show belong to *Megatherium*." In writing thus, Darwin was evidently, to some extent, the victim of a mistake into which naturalists had been betrayed at the beginning of last century. Whether, in using the words, placed between inverted commas by him, Darwin was quoting from some author, I have vainly endeavoured to discover by an examination of the books which he would probably have in his little library on the *Beagle*; but the query, which he puts in brackets, clearly shows that he suspected that an error had been committed. And this conclusion is confirmed by the sentence which follows:—

"Immediately I saw this I thought they must belong to an enormous armadillo, living species of which genus are so abundant here."

The history of the origin and spread of the idea that the dermal armour of the Glyptodonts belonged to the *Megatherium* is a very curious one.

It has been suggested that Dr. Buckland was responsible for the unfortunate error,¹⁵ but the passage quoted in support of this view is taken from the "Bridgewater Treatise," which was not published until 1836, and indeed contains a reference to Darwin's own work in South America. Buckland, like other geologists and zoologists of that day, merely followed the lead of Cuvier in this matter.

The remains of the gigantic fossil sloths of South America had found their way to Europe before the end of the eighteenth century, and both *Megatherium* and *Mylodon* were described by Cuvier in his "Ossemens fossiles" in 1812. But while preparing the fifth volume of the second edition of that great work in 1823, he received from a colleague, the botanist August de Saint-Hilaire, a letter sent with specimens from South America, by D. Damasio Larrañaga, curé de Montevideo. This letter, apparently without being carefully scrutinised by Cuvier and his assistants, was printed in a footnote,¹⁶ and contains the words "Je ne vous écris point sur mon dasypus (*Megatherium*, Cuv.)." The worthy priest, who was evidently not a zoologist, confounded *Dasypus* (the armadillo) with the *Megatherium*; and, strange to say, Cuvier not only allowed the passage to stand, but added the suggestion that *Megatherium* might have possessed bony armour like the armadillo, and that he awaited impatiently further information on the subject from Larrañaga. As bones of the giant sloths from South

⁸ "Journal of the *Beagle*" (1839), p. 46.

⁹ "Voyages of the *Adventure* and *Beagle*," vol. ii., p. 107; vol. iii., p. 112.

¹⁰ "Geological Observations on South America" (1846), pp. 82-85.

¹¹ "Voyages of the *Adventure* and *Beagle*," vol. ii., pp. 106-7.

¹² "Life and Letters of Charles Darwin," vol. i., p. 223.

¹³ *Ibid.*, vol. i., p. 276, note.

¹⁴ This letter was read at a meeting held on November 16, 1835, and was privately printed.

¹⁵ "More Letters of Charles Darwin," vol. i., p. 12, note.

¹⁶ "Ossemens fossiles," second ed., vol. v. (1823), p. 191, footnote.

America were often accompanied by portions of the bony armour, which occur in the same deposit, it is perhaps not surprising that the erroneous identification was caught up and repeated in other works on the subject.

It was not until 1840 that Owen in this country and Lund in Germany established the existence of the several genera of the Glyptodontidae, and showed that these bony plates really belong to extinct forms allied to the armadillos. It is therefore very interesting to find that the "untrained" naturalist of twenty-three years of age had divined the real truth on the subject so long before.

The specimen which excited such intense interest in Darwin's mind was described by him in 1846, after consultation with Owen, as follows:—

"A double piece, about three feet long and two wide, of the bony armour of a large Dasypoid quadruped, with the two sides pressed nearly close together: as the cliff is now rapidly washing away, this fossil was probably lately much more perfect; from between its doubled-up sides, I extracted the middle and ungual phalanges, united together, of one of the feet, and likewise a separate phalang: hence one or more of the limbs must have been attached to the dermal case when it was embedded."¹⁷

This fine specimen, which would undoubtedly have been of great historical interest, from the effect it produced on the young naturalist's mind, is unfortunately no longer in existence. Darwin says "It was so tender that I was unable to extract a fragment more than two or three inches square."¹⁸ Owen, in his memoir on the fossil bones sent home by Darwin, describes and figures two small fragments—"the portions of the tessellated bony dermal covering of a Dasypoid quadruped," and these are identified as belonging to the specimen in question by the statement that they "were discovered folded round the middle and ungual phalanges," which are also figured on the same plate.¹⁹

As evidence of the special interest which Darwin attached to this discovery, it may be mentioned that he at once sent home a fragment of this (or of a similar specimen) to his family, for we find him writing to his sister Catherine, on May 22, 1833:—"I am quite delighted to find the hide of the *Megatherium*" (he uses the term by which such specimens were then generally known) "has given you all some little interest in my employments."²⁰

Now, in order to appreciate the extraordinary effect of this discovery on young Darwin's mind, we must remember what were the opinions current among geologists when it was made. The views of Cuvier at that date were regarded as not less authoritative in geology than they were in zoology, and in the introduction to his *magnum opus*, the "*Ossemens fossiles*," the opinions of the great comparative anatomist were pronounced with no uncertain note. He contended that each geological period must have been brought to a close through the sweeping out of existence, by a great cataclysm, of all plant- and animal-life, this being followed by the creation of a perfectly new assemblage of living beings. Cuvier's teaching was made as widely known in this country as it was on the Continent, for Jameson issued a number of editions of a translation of the famous introduction, under the title of "An Essay on the Theory of the Earth"; and, as von Zittel justly remarks, "Cuvier's catastrophic theory was received with special cordiality in Eng-

land."²¹ By none certainly was it adopted more unreservedly than by Darwin's teachers and friends, Henslow and Sedgwick.

Among the books in Darwin's library, now piously preserved at Cambridge, is a copy of the fifth edition of the translation of Cuvier's "Essay," bearing the date of 1827,²² and I think there can be no doubt that this book was one of those constituting the little library of reference in the chart-room of the *Beagle*, where Darwin worked and slept. Nor can there be any hesitation in concluding that with the contents of this book he would be thoroughly familiar.

This being the case, Darwin found himself confronted at Punta Alta with the two startling facts which he so clearly indicates in his letter to Henslow.

First, the bones of gigantic and undoubtedly extinct mammals were seen to be associated in the same deposit with shells of living species. He tells Henslow at the time, "They" (the bones) "are mingled with marine shells which appear to me identical with what now exist." (He, in fact, collected twenty-five species, all of which D'Orbigny afterwards pronounced to be still living.) How, on Cuvier's theory, could such a state of things arise? The cataclysm that destroyed the mammalian must surely have been equally fatal to the mollusca!

But the *second* fact was even more striking and significant. Not only did Darwin obtain the armour of "an enormous armadillo," but among the other remains he identified the jaw of another of the Edentata, and the teeth of rodents similar to those now living in the district.²³ His recent collections had made him familiar with the peculiar mammalian fauna of South America, and the striking characters which distinguish it from that of all other portions of the globe, and here, he states, was evidence before his eyes that the mammals of the period immediately preceding our own, though differing in being more gigantic, presented a striking family likeness to them. This was a fact quite inexplicable on the theory of wholesale destructions and brand-new creations, but most suggestive, and capable of simple explanation, if the recent forms were descended from the fossil ones, or both were representative of common ancestors.

When Charles Darwin arrived home in 1836, and engaged in the preparation of his journal for publication, he found that almost simultaneously with his own discovery a similar one had been made with respect to the Australian continent. Clift had identified a number of bones collected in caves in that island as belonging to extinct marsupials, and Jameson had pointed out the significance of their relations with the existing fauna.²⁴ There can be no doubt, however, that Darwin was quite unaware of this publication while he was in South America, though he refers to it in writing up his journal. Facts like these, so familiar to us at the present day, were then quite novel.

But it is by no means improbable that the mind of the young naturalist was in a specially receptive condition, when it encountered the shock of this important discovery. Darwin has again and again insisted on the revolution produced in his mind on geological questions by the study of the first volume of Lyell's "Principles of Geology," which he took

²¹ "History of Geology and Palaeontology" (English translation), p. 141.

²² Catalogue of the Library of Charles Darwin, p. 19.

²³ "More Letters of Charles Darwin," p. 12.

²⁴ "On the Fossil Bones found in Bone Caves and Bone Breccias in New Holland," *Edinb. New. Phil. Journ.*, vol. x. (1831), pp. 390-7. In this paper the list of species is by Clift, but the remarks are by the editor, Jameson. The arguments are somewhat weakened by the larger marsupial bones having been mistaken for those of elephant or rhinoceros. It is remarkable that most authors, including Darwin himself, give Clift the credit for the generalisations, but this is not borne out by an examination of the paper.

¹⁷ "Geological Observations in South America" (1846), p. 84.

¹⁸ *Ibid.*, p. 86.

¹⁹ "Zoology of the *Beagle*," "Fossil Mammalia," plate xxxii., and description.

²⁰ "Life and Letters of Charles Darwin," vol. i., p. 245.

with him from England. In his dedication of the second edition of his "Journal," Darwin wrote, "The chief part of whatever scientific merit this journal and the other works of the author may possess has been derived from studying the well-known and admirable 'Principles of Geology.'"²⁵

In a letter to his friend, at the same time, Darwin clearly explains the nature of his indebtedness to the "Principles." He says, "Those authors . . . who, like you, educate people's minds as well as teach them special facts, can never, I should think, have full justice done them except by posterity, for the mind thus insensibly improved can hardly perceive its own upward ascent."²⁶ And shortly before this he had written to Leonard Horner, "I have always thought that the great merit of the *Principles* was that it altered the whole tone of one's mind, and therefore that, when seeing a thing never seen by Lyell, one yet saw it partially through his eyes."²⁷

It has been pointed out, both by Huxley and Haeckel, that when Lyell had completed the first volume of his great work he had arrived at the logical conclusion that the same principle of continuity or uniformity which he had demonstrated for the inorganic world must apply also to organic nature and even to man. This is clearly shown in the correspondence that has been published,²⁸ which also makes it manifest that some among Lyell's contemporaries who thought deeply on the subject could not avoid the same conclusion. Sedgwick clearly perceived this, and it moved him to rage and to making wild charges of "infidelity." Whewell saw it too, and shrank from accepting Lyell's doctrines because he could find no border-line between what he called "uniformitarianism" and evolution; but Herschel appears, at the time, to have been ready to go as far as Lyell himself. And the young naturalist on board the *Beagle*, did he begin to perceive, however dimly, "through Lyell's eyes" that evolution could not stop with the inorganic world? We have no evidence on this point; we can only conjecture it as possible.

This much, however, is certain, that Darwin, after completing his excavations at Punta Alta, returned to Monte Video, and among the articles sent from home which were awaiting him there, found the second volume of the "Principles," and wrote in it "Monte Video, November, 1832." The volume treats of the "Changes in the Organic World now in Progress." It is true that Lyell had been so far influenced by his friend Cuvier that he commenced the book with a very trenchant criticism of the theory of Lamarck, but he then goes on to discuss a number of problems of extreme interest and importance to the evolutionist—the limits between species and varieties; variation under domestication and in nature; the effects of crossing and the characters of hybrids; the geographical distribution of plants and animals, and the agencies by which it has been brought about; extinction and the appearance of new forms; the struggle for existence; the origin of instincts; and the bearing of all these and similar questions on the interpretation of the geological history of past times. Great as was the influence of the first volume on the mind of Darwin with regard to geological questions, I think no one can now read this second volume without realising that, in respect to biological problems, it must have exercised at least an equally profound effect upon him. It could be easily shown from the "Journal" that all these problems were, from this time forth, ever in Darwin's thoughts, and as new

observations were made by him, he delighted to think, as shown by his letters, that they would "interest Mr. Lyell," who was at that time not personally known to him.

I am very far from suggesting that the collection of the fossil bones at Punta Alta and the perusal of Lyell's second volume made Darwin an evolutionist. On the contrary, I fully admit, with Dr. Francis Darwin, that it was the series of wonderful relations revealed to him towards the end of the voyage, by his study of the faunas of the Galapagos Islands, that had the preponderating influence in moulding Darwin's views; and I am convinced that anything like a definite formulation of those views did not take place until after his return to England. It was then that, by the re-examination of his collections and the revision of the observations in his notebooks and journal, he was led to bring into close array the various facts and reflections bearing on "the species question," and thus the scattered gleams of light on the subject which he had from time to time caught were first brought to a focus in his mind; nevertheless, it is true that the first of those gleams were those that came to him at Punta Alta and during the perusal of the "Principles."

There is a passage in one of Darwin's letters to Bentham the significance of which, I think, has been somewhat overlooked. Speaking of the fluctuations of opinion on the question of the immutability of species, he says:—

"I, for one, can conscientiously declare that I never feel surprised at anyone sticking to the belief of immutability. . . . I remember too well my endless oscillations of doubt and difficulty. It is to me really laughable, when I think of the years which elapsed before I saw what I believe to be the explanation of some parts of the case; I believe it was fifteen years after I began before I saw the meaning and cause of the divergence of the descendants of any one pair."²⁹

Fifteen years after 1832 would bring us to 1847, a period at which Darwin was fully immersed in the task of "making and unmaking species" among the Cirripedes, and in their classification; and it may well have been the consideration of "one pair" of these that led him first clearly to realise "the meaning and cause of divergence." In his autobiography he wrote, "Long after I had come to Down" (which was in 1842) "whilst in my carriage to my joy the solution occurred to me," and "I can remember the very spot in the road."³⁰ Although, as Dr. Francis Darwin has shown,³¹ his father had come very near to this idea of divergence when he wrote the 1842 sketch,³² and the same is true with regard to the essay of 1844,³³ it was clearly after these dates that the full significance of the principle revealed itself to his mind, and that it was the result of pondering on questions of classification is shown by his letter of September, 1857, to Asa Gray, which he communicated to the Linnean Society in 1858. He there wrote:—"Each new variety or species when formed will generally take the place of and so exterminate its less well-fitted parent. This I believe to be the origin of the classification or arrangement of all organic beings at all times."³⁴

If this reasoning be correct, we obtain the date of a crisis in Darwin's mental development to which he himself attached the greatest importance. However this may be, the letter to Bentham proves what is often overlooked, that Darwin's mind vacillated

²⁵ "Naturalist's Voyage Round the World" (1860).

²⁶ "Life and Letters of Charles Darwin," vol. I., pp. 337-8.

²⁷ "More Letters of Charles Darwin," vol. II., p. 117.

²⁸ "Life and Letters of Charles Lyell," vol. II., pp. 36, &c.

²⁹ "Life and Letters," vol. III., p. 26.

³⁰ *Ibid.*, vol. I., p. 84.

³¹ "Foundations of the Origin of Species," p. xxiv.

³² *Ibid.*, p. 37.

³³ *Ibid.*, pp. 208-11. See also "Origin of Species" (1859), chap. xiii.

³⁴ "Linnean Society-Darwin-Wallace Celebration," p. 97.

for many years before reaching full conviction on the question of evolution. Nor is this surprising; no one can read the suggestive series of letters to Sir Joseph Hooker without realising how great and numerous were the "doubts and difficulties" through which the veteran botanist battled his way towards final acceptance of his friend's views. The publication of the Lyell correspondence showed that the author of the "Principles" at the time of the publication of the first volume was perfectly satisfied as to the truth of organic evolution; this has been insisted upon both by Huxley and Haeckel. Yet, while writing his second volume, Lyell fell so strongly under the influence of Cuvier (whose palaeontological work naturally fascinated him) that he not only rejected Lamarck's hypothesis, but at times seemed to hesitate about the evolutionary theory altogether. Again, no one reading Herschel's address to the British Association in 1845, in which the "Vestiges" is so severely handled, could realise the fact that in 1836 he was writing to his friend Lyell that he was satisfied that the principle of continuity was applicable to organic as well as inorganic nature. It is no disparagement to either of these great thinkers to admit that, while weighing carefully the arguments for and against evolution, they inclined sometimes towards one side and at other times to the opposite view, and, in the words of Darwin, underwent "endless oscillations of doubt and difficulty."

JOHN W. JUDD.

ANTHROPOLOGICAL RESEARCH IN NORTHERN AUSTRALIA.

ALL friends of anthropology will rejoice to learn that after an interval of some years Prof. W. Baldwin Spencer, F.R.S., has resumed his researches among the aborigines of Australia. The following particulars as to his work and his plans are extracted from a letter addressed to Mr. J. G. Frazer on September 13.

The Commonwealth Government of Australia is about to undertake measures for the settlement of the Northern Territory, and during the present year it sent a small party to make preliminary investigations in that region. The leadership of the party was entrusted to Prof. Baldwin Spencer. The members of the party went to Port Darwin, and from there across to Melville Island; then they returned to Port Darwin and travelled south about two hundred miles, after which they crossed the continent to the Gulf of Carpentaria. Amongst all the tribes examined by the expedition the belief in the reincarnation of the dead is universal, and the same is true of the notion that sexual intercourse has nothing, of necessity, to do with the procreation of children. "The latter fact," says Prof. Spencer, "is interesting because we now know that this belief exists amongst all the tribes extending from south to north across the centre of Australia." On the other hand, Prof. Spencer found among these northern tribes none of the *intichiuma* or magical ceremonies for the multiplication of the totems which form so important a feature in the totemism of the central tribes; nor could he discover any restrictions observed by the natives in regard to eating their totemic animals and plants. "The absence of *intichiuma* ceremonies," he adds, "is doubtless to be associated with the fact that the tribes in the far north live under conditions very different from those of the central area. They never suffer from drought or lack of food supply. This seems to show that the *intichiuma* ceremonies are a special development of tribes that live in parts such as Central Australia, where the food supply is precarious."

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In one or two tribes along the Roper River a very curious totemic system was discovered. Among these people a man must marry a woman of a particular totem, but the children take a totem different from both that of their father and that of their mother. For example, a man of the Rain totem must marry a woman of the Paddy-melon (a species of small kangaroo) totem, and their children are of the Euro (a species of kangaroo) totem. Again, a Porcupine man marries a Lizard woman, and their children are Bats. In these tribes each exogamous class has certain totems associated with it. Again, in these tribes the natives are convinced that the spirit children know into what woman they must enter, so that the offspring shall have the proper totem. Everywhere, too, among the tribes traversed by the expedition, the women and children believe that the sound of the bull-roarer is the voice of a great spirit who comes to take away the boys when they are initiated; but during the initiatory ceremony, when the boys are shown the *churinga* for the first time, they are informed that the noise in question is not made by a spirit, but by the *churinga*, or bull-roarer, which was used in the past by one of the mythical ancestors of the tribe. Lastly, Prof. Spencer could detect among these tribes no trace of anything like a belief in a supreme being. On the whole, he considers that, with minor variations, the beliefs of these northern tribes are closely similar to those of the central tribes.

Prof. Spencer hoped to start about November 1 for another expedition to Melville Island, the inhabitants of which he is particularly anxious to study, as they are hitherto practically uncontaminated by European influence. His intention is to reside among them until February. All anthropologists will look forward with keen interest to the publication of Prof. Spencer's fresh inquiries in this promising region. It is much to be regretted that his former colleague in research, Mr. F. J. Gillen, has been prevented by the state of his health from taking any part in these new investigations.

THE TAAL VOLCANO.

THE latest publication received from the Weather Bureau of the Philippines is entirely devoted to a violent eruption of the Taal Volcano, which took place on January 30 of this year. This volcano, which lies thirty miles south of Manila, is represented by a crater in a small island which rises from the centre of Lake Bombon. As this lake joins Taal in its activities it also must be regarded as an active crater. If its waters could be removed by the deepening of the channel of the river which now drains it, we should have a replica of Mount Aso, in South Japan, viz., a large crater about twelve miles in diameter with an active cone in its centre. The craters of these two mountains rank among the largest of which our world can boast, but they are by no means comparable with the largest in the moon. If, however, the crater plains of Taal and Aso could be lowered to the level on which these mountains grew, they would closely resemble many lunar volcanoes.

The written history of Taal commences in 1572. Since that time the volcano has been fifteen times in eruption, the last being that now under consideration. Often it has obliterated hamlets and villages round the lake, but its last effort has practically cleared out everything. The number of dead is given as 1335, but because so many were buried beneath the ash and mud the exact number will never be determined. Of all the inhabitants round the lake the only survivors appear to have been those who were absent from their